SCIENCE AND INDUSTRY

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# ORGANIC GARDENING

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## Why We Believe In Organic Fertilization

1. *IT PERMITS THE PROPER AERATION OF THE SURFACE SOIL.*
2. *IT ENCOURAGES THE GROWTH OF HELPFUL BACTERIA.*
3. *IT HELPS THE SOIL TO RETAIN THE NECESSARY MOISTURE.*
4. *IT REDUCES THE EROSION OF THE SOIL TO A MINIMUM.*
5. *IT PROVIDES AN IDEAL HABITATION FOR BENEFICIAL EARTHWORMS.*
6. *IT IMPROVES VASTLY THE TASTE OF THE FOOD GROWN.*
7. *IT GIVES BETTER, MORE ABUNDANT AND MORE LASTING CROPS.*
8. *IT ERADICATES THE CAUSES OF INSECT INCURSIONS.*
9. *IT RETARDS CONDITIONS WHICH BRING RUSTS AND BLIGHTS.*
10. *IT FURNISHES ALL THE MINERALS REQUIRED FOR PLANT GROWTH.*
11. *IT ENABLES THE PLANTS TO FORM AN ABUNDANCE OF VITAMINS.*
12. *IT PREVENTS THE HARDENING OF THE SURFACE SOIL BY RAIN.*

**JAN. 1943**

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# ORGANIC GARDENING

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## January, 1943

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BACK TO NATURE

# With the Editor

*Sunflower Seeds*

WE have shown time and again in this publication that a large contributing cause to the general ill-health of the public is due to devitalized food. Now, devitalized food, in this instance, is food which is grown under the regular commercial methods through the liberal use of the so-called chemical fertilizers. These artificial fertilizers produce crops that *look* all right. But there is a big difference in the inside structure—in the constituents—of food grown in this manner compared with food grown with natural fertilizer—such as compost, humus or loam. This artificially-grown food does not have the necessary minerals and vitamins.

The public is at the mercy of the grower of its food. The average person cannot tell by merely looking at a vegetable or fruit how it is grown, its real quality or its nutritional v a l u e—because appearances are deceiving. However, the average person can overcome this unfortunate condition—he *can* grow some of his own food if he has a bit of land or some garden area available. Not only that, but he can grow this food in such a manner, through the use of plenty of organic fertilizer or humus, that he can guarantee to himself a sufficiency of minerals and vitamins. And most important of all, food raised in this manner is not only more nutritious but it tastes much better than the usual commercial product.

This improvement in the healthful qualities of food is not a question of guesswork nor is it based on vague generalities or abstract theorizing. To a great extent it is based on the mycorrhiza fungus, the facts about which have absolutely been proven in England. The necessity for the presence of earthworms in the soil is also a factor and many other conditions must be met —conditions that are encouraged by a plentiful supply of humus.

Now what has all this to do with sunflower seeds? The answer to that is: much. If you want glowing health and circumstances permit you to raise some of your own food you may lay your plans so cleverly that you will obtain a maximum amount of vitamin-bearng food all the year round. Using a plentiful supply of compost you can grow health-giving vegetables in the summer. To preserve the vitamins for the winter by storing, canning or freezing these vegetables, however, presents perplexing problems. Some thought must be given to determine what food products can be easily stored and yet which will not lose too much of their nourishing qualities.

The sunflower is one such food. It is very easy to grow and takes little space. Regardless of whether you have a few acres or a few square yards to devote to gardening, be sure to plant some sunflowers. But in growing them, use plenty of compost. If compost is not available, then use plenty of purchased humus or other organic material such as bone meal. Another thing: in order to be sure that you have a fine crop, it is best to trench the ground for it. Dig a trench about one foot deep and one shovel-wide. Put in a goodly quantity of compost, mixing it well with the earth. By loosening up the earth in this manner, the plants will be enabled to get the maximum nourishment from the soil and the presence of the compost will give you a crop of sunflower seeds just bursting with nour-

# The Indore Method of Composting

**(Adapted from Mr. Broadbent's article in "The Gardner's Chronicle" of April, 13th, 1940)**


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*The Indore Process of Composting*

These intsructions for the making and management of a compost heap follow the method which was developed at Indore in Central India. The product which results is plant food of the highest quality. The method has the merit that not only is it truly economical, in that waste materials are salvaged, but also that weed seeds are destroyed and that vegetables grown with its use are disease resisting and of excellent food value.

MATERIALS.

The first requirement of the process is the collection and mixing of all plant residues, weeds, leaves, old straw and hay, bracken, reeds. seaweed, hedge trimmings, etc. Paper, worn-out clothing, leather and sacking can also be added after previous soaking in water. All green material should be withered and hard woody material cut into short lengths and crushed where possible by, for example, wheel traffic. Any very resistant lignins or leather can be transferred from heap to heap if the initial attack is insufficient to break them down.

The second requirement for the compost heap is animal manure, from horses, cattle, sheep, pigs, rabbits or poultry. This is essential. Nothing is better than freshly used nightsoil for this purpose, which, if the composting be well done and the night soil be immediately covered with humus, is safe and entirely without offence.

The most important constituent of animal manure is urine which on many farms is allowed to run to waste. If this material is not completely absorbed by the bedding under the animals, arrangements should always be made to lead it through the walls of the buildings (shippons, pig cotes or stables) into small bricked pits outside which are filled with peat, soil, sawdust or any available absorbent. These pits should be regularly emptied and the contents used in the compost heaps in the place of earth. By this means, the valuable urine is preserved and its virtues are incorporated into the bodies of fungi and bacteria in the compost heap, and subsequently into humus.

The third requirement is earth, lime as ground limestone or chalk, wood ash, or preferably a mixture of all three, needed as a neutralizing agent.

The fourth requirement is water. In general rain will supply this need (in fact it may be said that protection from rain is more important in this country than the provision of water, although there are occasions when it must be added). The heap must not be too wet, the consistency of a squeezed sponge being aimed at.

During the early stages of decomposition air is required in large quantities by the micro-organisms in the heap. This is obtained by diffusion from the atmosphere and it is obvious therefore that the heap must be made as loose as possible. In the later phases after the fungous stage is over and the material has crumbled and darkened in color the fermentation becomes anaerobic, i.e., no air is required from outside. The organisms obtain their oxygen from the decomposing material itself.

*MAKING THE COMPOST HEAP.*

1. COMPOSITION OF THE HEAP.

The preparation of the compost

takes place in square or rectangular heaps built on the sandwich principle on earth, NOT concrete. If possible, a bottom should be made in a similar manner to that of a haystack. Hedge trimmings, bush fruit prunings or other material which will act as an open base are suitable. This assists aeration. On this base the heap is built. It consists of a horizontal layer of about 6 inches of mixed organic wastes followed by a thin layer of about 2 inches of animal manure, followed in its turn by a good sprinkling of earth containing, where these are available, wood-ashes and lime preferably in the form of chalk or ground limestone. The layers of mixed organic wastes, manure and earth with wood ash and lime are repeated until a height of from 4 to 5 feet is reached. The final layer of manure should be about twice the previous thickness and the final sprinkling of earth should completely cover the manure.

In districts of heavy rainfall it is advisable to arrange for the finishing layer to form a double slope.

In most districts of England a temporary covering is ESSENTIAL to protect the heap against excessive rain. Boughs or poles should be laid across the heap to raise the covering.

## 2. SIZE OF THE HEAP.

The minimum size for a heap is 5 ft. x 5 ft. x 4 ft. high. With any size smaller the ratio of cooling surface to volume is too great. When making small heaps it is better to build the second up against the first and so on. The heat is then conserved. It can be planned so that the turnings, referred to later, follow each other and the benefits of a larger heap are thus maintained.

This principle of mutual protection should be used also for the making of larger heaps. The width may be increased to 15 ft. as a convenient maximum depending on the materials available, and the length is built in 5 ft. sections. It is better to complete these short sections instead of building in layers to the full dimensions of the heap, as the process will start at the earliest possible moment, and, in addition, since the sections are not kept separate, each as it is added is providing protection to its neighbor. There is the further advantage that the vertical chimneys referred to in the next paragraph can be more readily bored without standing on the heap.

The height may be from 4 to 5 ft. when first completed. It will sink to about 2 ft. 6 ins. to 3 ft. before turning is due.

It should be noted that space must be allowed for turning the heap. Two turns are required to complete the process.

## 3. SUPPLY OF AIR.

It is very important that the heap should be made as loose as possible in order to permit of copious aeration, and care should be taken not to step on the heap whilst building.

It has been found in this country that aeration can be greatly assisted by making in the heap vertical funnels of about 4 inches to 6 inches in diameter by means of a rod or crowbar. The chimneys should be about 3 ft. to 3 ft. 6 ins. apart and from 2 ft. 6 ins. to 3 ft. 6 ins. from the sides of the heap.

When completed, the heap is left for three weeks. An intense fermenta-

tion sets in during this period and the temperature rises to about 150 degrees F. The material inside the heap turns white, owing to the development of fungous growth.

4. FIRST TURN.

At the end of three weeks, the heap is turned, from one end, to a new site, care being taken to bring the outside to the inside of the re-made heap. Funnels should again be bored in the turned heap.

When turning for the first time, vertical slices should be cut, after the manner of cuttting bread, of about 9 inches to 1 ft. by means of a fork.

The temperature, which will fall towards the end of the first three weeks, again rises. Within ten days of the first turn the material starts to crumble and darken. Bacteria now take a leading share in the process.

5. SECOND TURN.

Five weeks after the first turn, that is to say about two months after the heap was originally made it is turned a second time. Again the outside is brought to the inside and, where necessary, protection from rain is given. No funnels are required after the second turn as the fermentation has now become anaerobic. A spade should be used to cut the heaps at the second turn, the slices being about 6 inches wide.

6. COMPLETION, POSITION OF HEAP AND GENERAL MANAGEMENT.

Three months after the process began, the material is ready for application to the land. It consists of a finely divided product of which about 80 per cent will pass through a sieve of six meshes to the linear inch.

Protection against excessive rain has already been mentioned . The opposite possibility of dryness must be watched for and if rain is insufficient water must be added. This must not be sluiced on to the heap with a bucket but sprayed either by a hose with a nozzle or from a can with a rose. If water is added at the time of turning, this rule does not hold and water from a bucket may be sprinkled on to the material cut from the heap before it is re-made into the new heap. This method should, however, be used WITH DISCRETION and the material be thoroughly mixed before it is added to the re-made heap in order to distribute the moisture. It has already been mentioned that the material should have sufficient moisture to give it the consistency of a squeezed sponge. That is the guide to which the maker should work. It is impossible to lay down a hard and fast rule concerning either the protection of the heap from rain or the addition of water in the absence of rain. The heap has life and must be looked after like all living things.

If a sheltered site can be chosen facing south and with a wind-break on the north, east and west, so much the better. This applies particularly where the heaps are only five to six feet square, and for these smaller heaps, where possible, protection should be given on three sides by means of walls or hedges. The system by which mutual protection is given by old and new heaps should also be used wherever possible.

ishment—minerals and vitamins.

Again, why all this fuss about sunflower seeds? For this reason: all during the fall, winter and spring you will be able to munch each day a small quantity of these seeds. They are easy to keep and storage presents no problems. They are clean; and may even be carried around in your purse or pocket. They are, as we have shown, ridiculously easy to grow. A failure with sunflowers is unheard-of. They have an oil which is even superior to olive oil and also possess a goodly percentage of proteins. They are tasty if eaten raw but some prefer them toasted. But of most importance—you produced these sunflower seeds yourself and you know their history. They are far more important to your health than all the vitamin pills you can purchase. They are really the *forgotten* food—whole-bodied and substantial—and should never have been relegated from the pantry into the parrot cage.

If there is room in your garden, plant a quick-bearing nut tree of some kind with two or three fruit trees—such as apple or pear. Tend these trees affectionately with compost, and in due season, they will produce healthful food for the dangerous winter season.

### *Mycorrhiza*

Few persons realize that the dividing line between successful crops and crop failures may be so close as to be hardly distinguishable. It is precisely like the balance between the alkalinity of the blood and the assaulting acids—where a change of less than ½ of 1 per cent either way would be tremendously dangerous to health. Take the matter of the presence of a little, inconspicuous fungus in the soil. Where this fungus is absent the roots will not take up the necessary amount of nourishment to grow healthy plants. Now, scientists as a whole, have given very little study to this phenomenon. Yet here is a subject of vast importance—particularly in the matter of the selection of a proper fertilizer. This fungus—it is called mycorrhiza – grows splendidly in humus—or in compost. It will not flourish where there seems to be no loam. Yet without this fungus it is impossible to have healthy plants.

Now, as I said before, very little study has been given to this mycorrhiza. That it is there and performs a useful purpose of some sort is known. But just why it is there—and how it functions—is still a mystery. It is not a parasite—it does not gain its sustenance from the roots of the plants which it covers but rather it is a partner to the roots. Together—the roots and this covering of mycorrhiza—are able to draw in sustenance from the surrounding soil.

As Sir Albert Howard characterizes this relationship in his book "An Agricultural Testament:" "Mycorrhizal association is the living fungus bridge which connects the soil and sap."

If the mycorrhiza is absent —for some unexplained reason, the roots will not take up the sustenance no matter how rich the soil may be. This was shown when some pine seedlings were planted a short while ago.

In the soil where they were deposited—there was no mycorrhiza—and the seedlings starved to death. Then new seedlings were put in this same soil—but this time the mycorrhiza was supplied—and the seedlings flourished.

Sir Albert Howard has been emphasizing the importance of this mycorrhizal association for many, many years but it took that outstanding example of those pine seedlings to turn direct attention to it in this country. He states: "This association is not confined to one particular forest crop. It occurs in most if not all our cultivated plants. . . . It is probably universal. We appear to be dealing with a very remarkable example of symbiosis (partnership) in which certain soil fungi directly connect the humus in the soil with the roots of the crop. . . .

"The complete scientific explanation of the working of this remarkable example of symbiosis remains to be provided. It would appear that in the mycorrhizal association

Nature has given us a mechanism far more important and far more universal than the nodules on the roots of the clover family. . . ."

Referring to the use of chemicals in ordinary commercial fertilizer and their effects upon the mycorrhizal association, Sir Albert Howard continues:

"It would not be difficult to compare plants grown side by side . . . . one manured with complete artificials, the other with freshly prepared humus. In the former there would be little or no mycorrhizal invasion: in the latter it would probably be considerable."

Another strange fact that is known—but which has not been satisfactorily explained—is the unusual termination of this partnership between the root and the mycorrhiza. In the end, after a lapse of a certain period of working harmoniously together, the root turns into a big bad wolf and gobbles up its partner—the mycorrhiza. Whether that ends the root's particular ability to assimilate nourishment is still a question but there is no question that such absorption of the mycorrhiza by the root is beneficial to the plant. Chemical fertilizers seem to prevent this. As Sir Albert Howard writes:

"Artificials tend either to eliminate the association altogether or to prevent the digestion of the fungus by the roots."

In the "New Garden Encyclopedia," edited by E. L. D. Seymour, B.S.A., at page 841 appears this statement:

"The study of mycorrhizal association is in its infancy, but may in time revolutionize our ideas of forestry and many of our fertilizing practices."

It is a pity we do not know more about this peculiar alliance — this mycorrhizal arrangement as scientists call it. We should know—and know intimately—just what function each partner—the root and the mycorrhiza—performs. Somewhere in or about this pooling of resources, a tremendously important chemical change takes place in the soil minerals immediately adjoining. These dead minerals —inorganic minerals we call them—are suddenly transformed into living organisms—into organic minerals—the kind of minerals that plants and human beings may use as nourishment. Whether the root and the mycorrhiza make this change together or the roots merely superintend the change being made by the mycorrhiza is not known—but that it will not take place without the mycorrhiza being present seems to have been proved conclusively.

### *Bonfires on the land*

Most of you know how I have talked against the burning of anything on the farm or in the garden. Burning of refuse — particularly organic refuse such as leaves, weeds, etc. is unsound in two counts: first, it wastes much valuable material that might be utilized in future compost heaps and thereby lessens the amount of fertilizer you can obtain and second, the heat of fire absolutely destroys much of the beneficial life in the soil without which your plants cannot prosper.

I remember when most folks believed that it was good for the field to burn it over in the fall after the grass was dried out. Many so-called experts used to maintain that the ashes of such fires helped to fertilize the ground during the next spring. Yet, our experiences this year make me confident that I have not been as adamant on the "bonfire business" as I should have been. What convinced me was a series of small fires our farmhand started along the edge of a field this early summer to burn up some corn-stalks, not being aware of our policy against fires on the land. Later, the field was sowed with barley. In due time the sprouts began to make their way to the surface and the field became a beautiful green *except* at those spots where the fires had been. These spots showed up a yellowish color. It was so distinctive that visitors to our farm remarked about it and called attention to the fact that the barley that did come through on the sites of the former fires quickly turned a yellowish color and didn't thrive as well as the rest of the field. Now, our farm-

hand simply couldn't believe his eyes. He refused to allow his prejudices against this new fangled idea of "no bonfires" to be brushed aside. He gave as his explanation for this lack of growth along the burned area that it must have been trouble with the automatic seeder which had been turned about at approximately those spots and thus the drills had probably not disgorged sufficient seed. He could give no reason, however, for the yellowish cast—and the weakness—of the few sprouts that did appear. To me, the test was conclusive. The heat of these tiny fires had been sufficient to kill off the bacteria in that particular soil and thus there was no opportunity for the mycorrhiza to carry out their regular work. Again, the earthworms also must have been cremated. Altogether it was a demonstration that enabled me to come to the firm determination that no more bonfires will be allowed on the soil that we are trying to cultivate.

J. I. Rodale

# Some Gardening Lessons from the Orient

By Sir Albert Howard

Reprinted from the Gardener's Chronicle (England)

SOME years ago in the course of a visit to Mr. F. A. Secrett's farms near London I saw, among many other interesting things, a large group of Dutch lights each growing a mixture of salad and other crops from which bunches of young carrots were being collected for Covent Garden. The removal of these carrots seemed to make little difference, as the frames still carried a full crop of other things. My curiosity was at once aroused at seeing one of the great principles of the agriculture and gardening of the Orient—namely, the mixed crop—being applied in this country. I naturally enquired about the origin of this innovation and its practical results under Western conditions. Mr. Secrett very kindly informed me he had seen it in a Chinaman's garden at Melbourne and forthwith had decided to try it out in his own intensive gardening. The net result was a substantial gain in total annual yield because the pore space of the soil was fully utilized and the assimilating surface of the lights was constantly taken up by a carpet of green leaves, which prevented that inevitable loss of time involved in allowing crops to be successional to each other, instead of making them overlap.

As this adaptation of cropping to a short growing season like ours is so obvious now that it has been demonstrated, the question naturally arises: Are there any more lessons which gardening in this country might learn from the Orient? I suggest there are at least the four with which this paper deals.

### 1. *The Intensive Cultivation of the Seedling*

As is well known, the most important crop in the world is rice because more of the total population of this planet depend on this cereal for their subsistence than on such crops as wheat or maize. Moreover, the most densely populated areas are those in which the main crop is rice.

Has rice cultivation anything to teach the Occident? I suggest it has. To obtain the best rice (a mycorrhiza former) it is essential to raise the seedlings on soil exceedingly rich in humus obtained partly from animal wastes. The young plants are thereby converted into veritable arsenals of such things as nitrogen, potash, phosphates and so forth, all in organic combination. By this means the seedlings, when transplanted in the mud of the rice fields proper, easily survive the transfer from a dry to a wet environment, in which a very different set of soil and moisture conditions prevails.

After transplanting, the rice seedlings undergo an interesting set of changes. The leaves soon lose their dark green color and turn pale yellow. This color change accompanies the extensive digestion of the contents of the leaf cells needed to produce the new root system before the leaves turn green once more and resume their normal functions. New leaves are then rapidly formed and a large assimilating surface is created. All this involves considerable delay. Nevertheless, transplanted rice always does better than the broadcasted crop, where there is no interruption in assimilation and growth. Obviously such a result can best be explained by the reserve of nourishment which the seedlings have collected in the nurseries.

The question naturally arises: Can similar results be obtained in other crops, including vegetables, by paying more attention to the seedling stage? In tobacco, I know from long experience, the answer is: Most emphatically yes. In garden crops in this country I find similar results can also be obtained if we always make a point of doing for the seedlings what the rice nurseries do for the rice plant.

When seeds are sown in drills or very shallow trenches, three-quarters filled with freshly prepared compost with a thin layer of soil above, and when transplanting is done in similarly treated soil, the results as regards speed of growth, yield, quality and resistance to pests is amazing and must be seen to be believed. Further, when in the spring such adverse factors as east winds, cold and drought, delay the planting out of hardening off boxes of seedlings raised in the usual mixture under glass, it is a great advantage to top dress such waiting seedlings in their boxes with finely divided compost. They respond at once, go on growing and much stronger plants result. Another method of obtaining quick results in the case of mixed salad crops is to top dress with compost, sow the mixed seeds on the composted surface and then cover them with a second layer of compost.

By these simple devices spectacular results can be obtained with compost in the first year without waiting for the restoration of the general fertility of the garden or allotment. In all cases—drills, shallow trenches, or top dressing—the residual compost in the course of after-cultivation gets mixed with and so enriches the general soil for the next crop.

In the manurial experiments of the future more attention might perhaps be paid to the nutrition of the seedling. This would bring the work on crops into line with the raising of live stock and with the nutrition of the expectant mother, in both of which a good beginning is half the battle.

### 2. *The Running Out of the Variety*

One of the difficulties in Western gardening is the running out of the variety. This occurs almost universally no matter whether the new crop is raised from seed or by vegetative reproduction. I am constantly told by experienced growers that this tendency to run out is on the increase. Now in the East such running out does not occur at all, as is seen in the cultivation of the vine in Central Asia and in the indigenous types of sugar cane in the Gangetic plain.

The varieties of grapes grown in Persia, Afghanistan and on the Western Frontier Districts of India have been cultivated for a very long

time, but they show no signs of weakness. How very different is the story in the great grape-growing areas of the South of France, for example. There new varieties are constantly needed to replace the old.

In the case of the sugar cane in the United Provinces of India, the indigenous varieties have been grown mixed for some twenty centuries as is indicated by the fact that they have retained their Sanskrit names. Nowhere in the records of the past does one find any reference to plant breeding or to the creation of new forms. When, however, we study the cane under plantation conditions, the story alters. Plant breeders have been called in, particularly of late years, to produce a constant stream of new varieties, all of which then need elaborate trials in the field and in the factory.

Why does the variety persist in the East and run out under Western conditions? Is there any factor in these two systems of farming which might account for this marked disparity? I suggest the cause of the trouble will be found in the u n b a l a n c e between arable land and live stock, which has crept into Western farming and gardening, as one of the consequences of the views now current that a substitute has been found for humus in a complete dessing of artificials. It is true this substitution has often yielded a temporary profit until the natural reserve of humus in the soil has become exhausted. Then trouble begins, one aspect of which is the running out of the variety.

If this view is correct, it would follow that whenever crops like sugar cane and the vine occur in a properly balanced agriculture and when some form of farm yard manure is employed to maintain soil fertility, the variety will, to all intents and purposes, be eternal. This state of affairs, as I have already said, is the rule in both the vine and the sugar cane in Oriental farming. It was also the case in the West before the disciples of Liebig sowed the seeds of future trouble when they persuaded the world that the use of chemical manures was firmly established by the results of the Broadbalk plots of Rothamsted. In the West Indies, for example, the Bourbon cane reigned supreme till artificial manures became general. It then collapsed and has since been followed by a succession of new seedling types.

How can artificials alter the constitution of plants and initiate this running out process? I suggest the answer will be found in the gradual reduction of the fertility principle carried into the plant from a soil in good heart by means of the mycorrhizal association. This association is the means by which fungous threads, rich in protein, are digested by the roots and carried in the sap to the green leaves. As humus is replaced by artificials, this agency in the feeding of plants gradually disappears and as it does so the capacity of the plant to reproduce itself gradually fails. In other words, the running out process is a natural consequence of methods of manuring which have failed to pass the test of time. What seems to matter in the stability of the variety is the circulation of protein from soil to plant and animal, and back again to the soil by way of properly constituted humus. If we interpose a substitution phase in Nature's round, we weaken one of the links in the wheel of life and a breakdown soon follows.

This view can easily be put to the test. The behaviour of the same variety, whether propagated by means of seed or vegetatively, can be followed through a number of successive generations, one set of plants being grown on land manured with freshly prepared humus, the other set by means of an equivalent dressing of artificials. In this comparison, each harvest must, of course, produce the seed for the next sowing. No change of seed from an outside source should be made at any stage.

While these fundamental experiments are in progress, gardeners and growers who are humus-minded might take steps to raise their own seed, budwood, cuttings, tubers and the like, from soil manured

with freshly prepared compost and so anticipate the results of the long term trials suggested above, which can best be carried out at an Experiment Station. If a few were to record their experiences in the pages of this journal, we might soon hear much less about the running out of the variety.

3. *Hydroponics.*

We read nowadays a great deal about soil-less culture and the possibility of raising commercial crops by means of hydroponics—solutions of appropriate chemicals circulating in tanks or allowed to percolate over beds of sand and gravel. But nowhere have I found any reference to the way the cultivators of the Orient carry out their essays in water culture in such a manner that the crops can also utilize the mycorrhizal association and so derive the fullest possible benefit from humus. In the upland valleys of Central Asia it is no uncommon sight to find floating gardens on the great lakes. These can most easily be seen on the lakes in the Kashmir valley where there is a very gentle flow of fresh water and where the depth is considerable. These gardens are made of rafts of rough timber supporting a layer of humus about a foot thick on which crops of the melon family are raised. There is an extensive root development all through the humus layer which is kept moist by contact with the lake water. No chemicals are, of course, needed. All the floating gardens I saw in 1910 were quite healthy and the plants were doing well. I had no leisure unfortunately to examine the root system in much detail, but it is more than possible that the mycorrhizal association will be seen in operation in these floating gardens. I hope some live wire who reads this article will carry the matter further and compare the behavior of vegetable marrows, when grown under hydroponics with the help of chemicals, with similar plants raised on some of our fresh water ponds in the manner in vogue in Central Asia. We might, in this way, obtain useful information on the influence of artificials on quality and the life of the variety. It may be that even in such new departures as hydroponics we may learn a little from the East.

4. *The Treatment of Disease*

One of the subjects which continues to take up a large amount of space in the periodicals dealing with gardening is disease and its treatment. It is now almost impossible to take up one of these journals without finding a description of some new disease, or some better method of controlling the old ones by means of poison sprays, powders and so forth.

How do the cultivators of the Orient deal with the insect, fungous and virus diseases of crops? The answer to this question is a very simple one. There is remarkably little disease to combat, so nothing is done. Even when in the hot season, April to June, occasional swarms of locusts from the deserts of Rajputana invade the great plains of India and damage the evergreen trees and the small area of irrigated crops, these pests do no permanent harm and fade out as soon as the rains come. Locusts in India, during the twenty-six years I worked there, never once established themselves outside their desert home.

Perhaps the best examples of gardening in India without any noticeable disease are the highly manured areas surrounding the 500,000 villages which constantly receive dressings of both human and animal manure. I often examined these crops, but never found any trace of disease. The same applies to the well irrigated areas where again the soil is kept in a high state of fertility by means of farm yard manure. This experience was again repeated in the vineyards of the tribesmen on the Western Frontier. Here the vines are planted on the floors of deep trenches and trained on the vertical earthen walls. Farm yard manure only is used and the irrigation water is led along the bottom of the deep ditches. But even under conditions which at first would encourage mildew,

I never found any trace of disease, insect or fungous, on the vines or on the grapes.

I should like to quote my own experience at Blackheath. In 1934 I purchased a house, the garden of which was completely worn out through no fault of the previous owner. It was a veritable pathological museum—the fruit trees, in particular, were smothered with every kind of blight. Steps were taken to convert all the vegetable wastes into humus with the help of stable litter. Even after one year the pests began to retreat. In three years all had disappeared, the wooly aphis on one apple tree being the last to leave. During this period no insecticides or fungicides were used and no diseased material was ever destroyed. It was all converted into humus.

One further interesting result must be mentioned. I grew in heavily composted soil a collection of Royal Sovereign strawberries, badly infected with a common virus disease, alongside some healthy stock. This year, 1942, the strawberries raised from these two sets of plants were about the best I have ever tasted. I found no trace of the virus disease. Similar results have been obtained by several of my correspondents.

May it not prove that the vast amount of disease in this country will be traced to our methods of manuring and the substitution of chemicals for properly synthesized humus? At any rate, the connection, if any, between natural methods of manuring and the control of disease might be examined forthwith.

# Vegetable Mold and Earthworms

By Charles Darwin

A Condensed Version of the Famous Book Published in 1882

Eighth Installment

**This installment completes the summary of this most remarkable book. To the average reader these revelations must have come as a distinct shock. Far too few persons know the real place of the earthworm in our scheme of life on this planet and understand the necessity of conserving—rather than destroying—these helpful little creatures.**

A space was selected (October 9th, 1870) on a broad, grass-covered terrace, which had been mowed and swept during many years. It faced the south, but was shaded during part of the day by trees. It had been formed at least a century ago by a great accumulation of small and large fragments of sandstone, together with some sandy earth, rammed down level. It is probable that it was at first protected by being covered with turf. This terrace, judging from the number of castings on it, was rather unfavorable for the existence of worms, in comparison with the neighboring fields and an upper terrace. It was indeed surprising that as many worms could lie here

as were seen; for on digging a hole in this terrace, the black vegetable mould together with the turf was only four inches in thickness, beneath which lay the level surface of light-colored sandy soil, with many fragments of sandstone. Before any castings were collected all the previously existing ones were carefully removed. The last day's collection was on October 14th, 1871. The castings were then well dried before a fire; and they weighed exactly 3½ lbs. This would give for an acre of similar land 7.56 tons of dry earth annually ejected by worms.

The second square was marked on unenclosed common land, at a height of about 700 ft. above the sea, at some little distance from Leith Hill Tower. The surface was clothed with short, fine turf, and had never been disturbed by the hand of man. The spot selected appeared neither particularly favorable nor the reverse for worms; but I have often noticed that castings are especially abundant on common land, and this may, perhaps, be attributed to the poorness of the soil. The vegetable mould was here between three and four inches in thickness. As this spot was at some distance from the house where the lady lived, the castings were not collected at such short intervals of time as those on the terrace; consequently the loss of fine earth during rainy weather must have been greater in this than in the last case. The castings moreover were more sandy, and in collecting them during dry weather they sometimes crumbled into dust, and much was thus lost. Therefore it is certain that the worms brought up to the surface considerably more earth than that which was collected. The last collection was made on October 27th, 1871; i. e., 367 days after the square had been marked out and the surface cleared of all pre-existing castings. The collected castings, after being well dried, weighed 7,453 pounds; and this would give, for an acre of the same kind of land, 16.1 tons of annually ejected dry earth.

We have no means of judging how great a weight of earth a single full-sized worm ejects during a year. Hensen estimates that 53,767 worms exist in an acre of land; but this is founded on the number found in gardens, and he believes that only about half as many live in corn-fields. How many live in old pasture land is unknown; but if we assume that half the above number, or 26,883 worms live on such land, then taking from the previous summary 15 tons as the weight of the castings annually thrown up on an acre of land, each worm must annually eject 20 ounces. A full-sized casting at the mouth of a single burrow often exceeds, as we have seen, an ounce in weight; and it is probable that worms eject more than 20-full-sized castings during a year. If they eject annually more than 20 ounces, we may infer that the worms which live in an acre of pasture land must be less than 26,886 in number.

Worms live chiefly in the superficial mould, which is usually from 4 or 5 to 10 and even 12 inches in thickness; and it is this mould which passes over and over again through their bodies and is brought to the surface. But worms occasionally burrow into the subsoil to a much greater depth, and on such occasions they bring up earth from this greater depth; and this process has gone on for countless ages. Therefore the superficial layer of mould would ultimately attain, though at a slower and slower rate, a thickness equal to the depth to which worms ever burrow, were there not other opposing agencies at work which carry away to a lower level some of the finest earth which is continually being brought to the surface by worms. The soil is actually increased, though only to a small degree, through the agency of worms; but their chief work is to sift the finer from the coarser particles, to mingle the whole with vegetable debris, and to saturate it with their intestinal secretions.

Finally, no one who considers the facts—on the burying of small objects and on the sinking of great stones left

on the surface—on the vast number of worms which live within a moderate extent of ground—on the weight of the castings ejected from the mouth of the same burrow—on the weight of all the castings ejected within a known time on a measured space—will hereafter, as I believe, doubt that worms play an important part in nature.

Not only do worms aid indirectly in the chemical disintegration of rocks, but there is good reason to believe that they likewise act in a direct and mechanical manner on the smaller particles. All the species which swallow earth are furnished with gizzards; and these are lined with so thick a chitinous membrane, that Perrier speaks of it, as "une veritable armature." The gizzard is surrounded by powerful transverse muscles, which according to Claparede, are about ten times as thick as the longitudinal ones. In the same manner as gallinaceous and struthious birds swallow stones to aid in the trituration of their food, so it appears to be with worms. The gizzards of thirty-eight of our common worms were opened, and in twenty-five of them small stones or grains of sand, sometimes together with the hard calcareous concretions formed within the anterior calciferous glands, were found, and in two others concretions alone. In the gizzards of the remaining worms there were no stones; but some of these were not real exceptions, as the gizzards were opened late in the autumn, when the worms had ceased to feed and their gizzards were quite empty.

When worms make their burrows through earth abounding with little stones, no doubt many will be unavoidably swallowed; but it must not be supposed that this fact accounts for the frequency with which stones and sand are found in their gizzards. For beads of glass and fragments of brick and of hard tiles were scattered over the surface of the earth, in pots in which worms were kept and had already made their burrows; and very many of these beads and fragments were picked up and swallowed by the worms, for they were found in their castings, intestines, and gizzards. They even swallowed the coarse red dust, formed by the pounding of the tiles. Nor can it be supposed that they mistook the beads and fragments for food; for we have seen that their taste is delicate enough to distinguish between different kinds of leaves. It is therefore manifest that they swallow hard objects, such as bits of stone, beads of glass and angular fragments of bricks or tiles for some special purpose; and it can hardly be doubted that this is to aid their gizzards in crushing and grinding the earth, which they so largely consume. That such hard objects are not necessary for crushing leaves, may be inferred from the fact that certain species, which live in mud or water and feed on dead or living vegetable matter, but which do not swallow earth, are not provided with gizzards, and therefore cannot have the power of utilizing stones.

The trituration of small particles of stone in the gizzards of worms is of more importance under a geological point of view than may at first appear to be the case; for Mr. Sorby has clearly shown that the ordinary means of disintegration, namely running water and the waves of the sea, act with less and less power on fragments of rock the smaller they are. Nor should we forget, in considering the power which worms exert in triturating particles of rock, that there is good evidence that on each acre of land, which is sufficiently damp and not too sandy, gravelly or rocky for worms to inhabit, a weight of more than ten tons of earth annually passes through their bodies and is brought to the surface. The result for a country of the size of Great Britain, within a period not very long in a geological sense, such as a million years, cannot be insignificant; for the ten tons of earth has to be multiplied first by the above number of years, and then by the number of acres fully stocked with worms; and in England, together with Scotland, the land which is cultivated and is well

fitted for these animals, has been estimated at above 32 million acres. The product is 320 million million tons of earth.

*Conclusion*

Worms have played a more important part in the history of the world than most persons would at first suppose. In almost all humid countries they are extraordinarily numerous, and for their size possess great muscular power. In many parts of England a weight of more than ten tons of dry earth annually passes through their bodies and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mould passes through their bodies in the course of every few years. From the collapsing of the old burrows the mould is in constant though slow movement.

The plough is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly ploughed by earth-worms. It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures.

EDITOR'S NOTE: This finishes the summary of "Vegetable Mold and Earthworms" by the eminent scientist, Charles Darwin. In the near future we will publish this complete summary in a book which we are now preparing covering many interesting phases of organic farming.

# Hints for the Victory Gardener

## SQUASH

**This is the second of a series of articles by this author dealing with the cultivation of ordinary vegetables.**

**By Roger W. Smith**

BECAUSE the production of home-grown foodstuffs is now a matter of nationwide concern, it follows that an estimate of the value of any garden item should include: (1) the length of time the vegetable is available fresh-picked, (2) the ease and length of time it can be held in storage. The squash rates high on both these points.

The squash flourishes in practcially every part of the country where enough moisture is available. It is indigenous to our land, a truly native American plant. By the Indians it was well loved and called "asquash"—the green, raw one.

Squashes are divided into two types, summer squash and winter squash. Both types succeed in reasonably rich soil, although they favor a sandy loam. You will find both types easy to cultivate provided you start from the ground up.

Regardless of the condition of the garden, greater success will be assured you if you dig in about a wheelbarrow load of well composted humus per hill. Any spot in the garden where more than one plant is to grow in a group is called a hill.

The soil should not only be enriched by the addition of good humus, it should be as carefully prepared as you can make it.

It will pay you to keep in mind the idea that the squash plants will have to be so vigorous that they will succeed in reaching maturity and developing their fruits before insect enemies and diseases can cut them down.

If you take care of the place where the squashes are to grow, you will find raising

them for the first time a happy and instructive experience.

Squash seed should not be planted until all danger of frost has passed and the ground has warmed up. This is about the same time that sweet corn is being planted in your locality.

For summer squash it is better, perhaps, to select one of the bush types like Patty Pan, which matures in 54 days, or one of the bright Summer Crooknecks.

The seeds should be planted an inch deep, not more than four seeds to the hill, and the hills spaced four feet apart each way. Depending upon the type of summer squash you select (and there are so many good ones you will most likely have some difficulty making a selection) a half ounce of seed should plant from ten to fifteen hills.

Use good seed. Avoid planting it too thickly. With squashes it is a waste of seed to plant thickly and thin out afterwards. It is better to save any extra seed. Properly stored it will remain viable up to four years.

As soon as the seed is in the ground and properly firmed, the good gardener thinks about the protection of the young plants soon to appear.

Although squash plants grown in rich, deep soil will usually succeed with no more attention than moderate cultivation to keep down weeds and to insure sufficient moisture, it is best to get them off to a good start.

One of the best ways to protect young squash seedlings against the attacks of disease-carrying striped-beetles is by the box method. For each hill, take a box of wood, or heavy fiberboard, about eighteen inches square and twelve inches deep from which both the top and bottom have been removed. Press the box firmly over the hill and bank a little earth up around it. Over the open top a piece cheesecloth is stretched and held in place with tacks or some similar method.

A very old method was to place two barrel staves in the form of a cross over each hill. Tie the staves at the point where they cross, then cover them with a piece of cheesecloth. A little earth drawn up over the edges of the cloth will hold it in place against winds.

Lacking boxes or barrel staves, it is quite practicable to drive three or four stakes into the ground close around each hill so that the stakes stand about a foot high. Cover the stakes with about a yard of cheesecloth to form a small tent and secure the edges with heaped earth.

Besides defending the seedlings against beetles and other insect pests this protection speeds up their growth. It should be removed promptly when the plants outgrow it. This is best done on a dull, clouded day.

As soon as the protection is removed the plants should be dusted with finely powdered wood ashes, care being taken to cover the stems and the area around their bases.

Dusting with wood ashes has a tendency to discourage insect pests, and the material, when it finally washes down to the roots of the plants, is beneficial to their growth.

Even so, as the plants grow larger you will find squash bugs attacking their foliage. These bugs live by sucking the juices from the plant. They can be trapped by placing pieces of board and the like on the ground near the plant. The traps should be emptied early each morning.

If you notice patches of the shiny brown eggs of the squash bugs grouped on the underside of the leaves, it is worth your while to crush them by hand.

But it is not worth while to get unduly alarmed by these pests. If you observe closely, you will notice that squash bugs, aphids, and many destructive insects almost invariably attack the weaker plants. Squash bugs carry the idea so far as to seem to have a preference for weak or wilted leaves. Plant disease fungi also have a tendency to attack weak specimens.

From this small beginning you will see how essential it is to do everything you can to have strong-growing, robust plants.

Healthy, disease resistant growth can best be obtained

by supplying plenty of good humus from a well made compost heap rich in natural, easily assimilated plant food. During the warmer weather a few inches of compost humus applied as a summer mulch around the hills greatly assists also in maintaining the moisture content of the hills.

When the squash plants are fully grown and developing their fruits, you will probably find that some of them have suddenly wilted.

If you examine the stem of one of the wilted plants closely, you will find a large white grub (the squash borer) living inside the stem. These grubs can be removed by slitting the stem lengthwise at the points where external signs indicate their presence. If the slit stem is afterwards placed in close contact with the ground and a little earth heaped over it, new roots will form at the nearest nodes.

Again, it is well not to be unduly alarmed. Squash borers generally do not attack until a good growth has been made. Virile plants usually manage to mature their fruits before the borers damage them too severely. Strong growing squash vines often drive adventitious roots into the earth as they spread, so that it is not rare to find a vine in good health even though it has been almost completely severed from its original roots by the borers.

Summer squashes, including the marrows and zucchini types, should be harvested as needed by the household during the summer and early fall. They should be used while the rind is still soft enough to be easily marred by pressure with the edge of the thumb nail. The zucchinis are best used whilst extremely young.

For this reason it is advisable to plant only enough hills of summer squash to meet the home demands of this vegetable. But you can secure a succession of ripening and thus a longer period of summer harvesting by selecting two types of summer squash. You can plant one that matures in fifty-five days (Bush Marrow) and another that matures in eighty-five days (one of the Acorn types).

The bulk of the hills, however, should be given over to winter squash, the rugged Blue Hubbards, the Buttercups, and the Delicious types. These are planted and cared for in the same manner as the summer squashes except that the hills should be about ten feet apart each way.

Winter squashes require from 125 to 160 days to mature. They should be harvested for storage before frost touches them.

Select for storage only hard-shelled, sound squashes. You will find that the shell of a well-ripened winter squash is almost unmarked by pressure with the edge of the thumb nail.

They should be washed quite clean especial care being taken with that part which rested upon the ground. They should be dried carefully and examined closely for marks of injury.

A dry place in the cellar or basement where the temperature remains between forty and fifty degrees Fahrenheit is the best place for their storage. It is feasible to store squashes at much higher temperatures (between sixty and sixty-five degrees Fahrenheit) but they will dry out more rapidly at higher temperatures and thus will not remain edible for as long.

You will find it best not to stack squashes but to place them in single layers or rows on shelves well off the floor.

Immediately after the work of harvesting and storing squashes is complete, the next step might well be to suggest to the Victory gardener's wife that she look up some good recipes for cooking them—squash baked with plenty of salt and pepper and a rasher of bacon—squash pie, that some contend has a more delicate flavor than pumpkin pie—and so on.

During the winter it pays to wipe and examine stored squashes occasionally to prevent condensed moisture from encouraging superficial moulds. These moulds, if neglected, can eventually become deep-rooted. They will penetrate and destroy large parts of the inside of the squash without greatly mar-

ring its surface if not cleaned away.

Properly stored squashes will keep until the following spring.

Squashes will harvest from ten to fifteen tons to the acre.

If you have grown several varieties, you will find it interesting to dry out a few seeds and save them for planting the following spring. Few garden experiences are more instructive than to watch the differently shaped and variously colored squashes these seeds will produce.

Planting a hill with a few cross-bred squash seeds might serve as your pleasant introduction to the vast and complicated subject of plant hybrids and plant variation.

If you have a few squashes left over at the close of the winter, these can be put to good use. If a small disk is cut in the side of the squash and the squash placed near a stove, it will soon dry out. Most of the seeds can then be shaken out of it.

Long before the arrival of the white man, Indians suspended these dried squashes for the wrens and martins to use for nesting houses. Whilst the ground is still hard frozen and the trees are bare, you might like to place a few in position near your garden.

And much later next spring, as you watch a wren busily building a nest in one of your last year's squashes, you will probably realize that it is about time to think of getting busy yourself with a few more hills of squash for the coming season.

Good luck to you.

# California Compost Piles

LATELY the construction of a certain type of compost heap—popular with flourists and plant nurseries on the Pacific coast—has been described at length in an article in the Los Angeles Times. The dimensions of these California compost heaps are tremendous, and their very size makes them hardly suitable for the average gardener. The methods used in the making of this compost, however, should prove interesting. The fertilizer or humus—made in this way—is used by these California plant nurseries for filling their "flats" in which seeds are sprouted.

A large pile is started with soil. It measures 40 feet long by 20 feet wide by 7 feet high. Its base is likely to be composed of 1½ feet of soil. Then there's a layer of horse manure 1 foot thick. On top of this is dumped one foot of bean straw; then another one and one-half feet of soil; topped with two feet of horse manure; then one and one-half feet of soil and on top of the entire pile there probably will be two feet of black peat plus a sprinkling of bone meal.

All the first year this pile remains untouched. It is aged and mellowed by the weather. During the second year the entire mass, which has shrunk considerably, is turned over three times by hand. This thoroughly mixes all the ingredients. The third year this soil is used.

Two years is a long, long time to wait for humus—and we cannot but wonder whether or not this delay is necessary. It is our opinion that the adoption of Sir Albert Howard's "Indore" method would accomplish the same results, and in months of time rather than in years. Under the "Indore" system the heaps could be made 50 feet long, 15 feet wide, and 5 feet high, and would have practically the same capacity as the gigantic California piles. Yet this "Indore" mammoth heap would turn out the finished humus within 3 months. Incidentally, this mammoth "Indore" heap would require no more

manual labor than must be devoted to the making of humus by this slow California method.

Changing this California Compost Pile idea into the Indore Method for making compost heaps would be simple: using the Indore Method the first, or bottom layer of material, would be leaves, old straw, grass or other organic matter. This organic material would be some six inches thick. On top of this—the second layer—would be two or three inches of manure, garbage or other animal waste material. The third layer—one or two inches—would be ordinary earth with which a small amount of lime or wood ashes is mixed. Now, the next layer is exactly the same as the first—made up of leaves, or grass or other waste material six inches thick. On top of this comes another two or three inches of manure, garbage or other animal material — the same as the second layer. Then comes another layer of earth—one or two inches—with which a small amount of lime or wood ashes is mixed—as was done with the third layer. On top of this comes another layer like the first and so on until the heap is completed. When it is about five feet high you put over the whole mound a layer of ordinary earth—three to six inches in depth.

To let in the air you would bore holes—with an iron pipe or crowbar—along the top of the pile at intervals of say four feet. You would work these holes until they were about six inches in diameter and would extend downward to the ground.

The pile would now be complete but at the end of three weeks it would have to be turned over—the outside material being dumped into the center of the new pile so that this material could be worked upon by the bacteria. Again the ventilating holes or air tunnels in the top would have to be made.

At the end of five weeks after the first turn, the pile would once more be turned over—the outside material again going into the inside. When this second turn has been completed no tunnels for air need be made. This second turn finishes the heap except for aging. Now, just leave the heap alone for about 4 weeks or so and the compost is ready for the garden or the farm. Thus to obtain the finished fertilizer takes about three months of time.

That is the Indore System for making Compost Heaps. If these piles are kept well dampened, the compost will furnish a rich, mineral-impregnated plant food that will make real vegetables and flowers.

Of course the heaps do not have to be so gigantic as those used in California. For the home garden the heap may be 6 feet wide at the base, 6 feet long and about 5 feet high. That would be the "starting" dimensions because within two or three weeks the height would have sunk to about 2½ feet.

*No Manure on the Lawn*

Along, about this time of year, or perhaps earlier, many misguided gardeners give their lawns a mulch of manure. Don't do it!

Far from being beneficial, it is detrimental to the lawn, because weed seeds are often introduced. Moreover, the manure is often applied in lumps, so that some of the grass is smothered out.

If the intent is to furnish nourishment to the grass, very very, little plant food is contained in manure.—*Practical Farmer.*

# Notes and Sparks

*The Manure Problem*

Manure is always a problem in town gardens. There is no complete substitute for it. The vital plant foods which it contains can be added to the soil in chemical form but this will not have any effect upon the mechanical condition of the soil nor will it stimulate healthy bacterial action in the same manner as animal manure. Some soils contain enough organic matter, or "humus" as the gardener terms it, to carry them on for a good many years, but far more deficient from the outset in this invaluable ingredient and, if results are to be entirely satisfactory, it must be added in some form or other.

Decayed refuse, including dead vegetable leaves, grass clippings, etc., are usually available but not in sufficient quantity to treat the whole of the vegetable garden adequately. A dressing of 1 cwt. to 20 sq. yds is about the minimum that can be regarded as useful and that means three quarters of a ton for an allotment of ordinary extent.

Peat and leaf mould are both serviceable but rather too expensive for widespread use. However, it should be borne in mind that these substances are light in proportion to their weight and consequently will go further than dung or compost. A couple of cwt. of either will dress a 10-rod plot and, incidentally, can be used safely even on the root crop plots, whereas, unless very well rotted and thoroughly worked in, is not to be recommended here as it may cause forking of the roots.—*Better Health Magazine* (England).

NOTE: The use of peat as a fertilizer in this country is not feasible to any great extent. However, the adding of a small amount of peat to compost heaps would bring many essential minerals to the compost.

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*Pruning*

Keep the pruning shears out when you are putting garden tools away for the winter. Pruning is a winter job; except for some of the flowering shrubs, every tree and bush should be introduced to the pruning shears.

The cane fruits (raspberries, blackberries, dewberries, gooseberries) can be handled nicely in winter when plants are bare of leaves. Next year's crop is borne on canes produced this year. Old canes should be cut out.—*Everybody's Poultry Magazine.*

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*Lime*

When a soil needs lime it is said to be acid, and the amount of acid in the soil can be accurately measured. To measure it, the chemist makes use of an instrument known as a potentiometer which records the acidity in pH values much as a thermometer, placed in the same soil, would record its temperature in degrees. The Fahrenheit thermometer scale runs from 0 to 212, and the pH scale runs only from 0 to 14. But just as the best temperature for crops is a little less than half-way between the two extremes, so also the soil is in the best condition with respect to the growth of most crops when its pH is a little less than 7, the half-way point. (Important exceptions to this rule are potatoes, sweet potatoes, and blueberries, the soil pH for which is normally kept at about 5.2).—*Practical Farmer.*

# Some Problems of the Dairy Farmer

By Sir Albert Howard, C. I. E., M. A.
Formerly Director of the Institute of Plant Industry Indore, and
Agricultural Adviser to States in Central India and Rajputana.

WHAT is the real nature of disease? Why are dairy animals so prone to attack by the organisms associated with contagious abortion, Johne's disease, mastitis and tuberculosis and to virus troubles like foot-and-mouth? Is there any method of preventing these afflictions?

If these questions can be answered, now is the time to do so because every year disease takes a heavier and heavier toll.

The loss to the farmer has, of course, to be made good by the public in the price paid for milk. Cattle disease, therefore, involves the nation as a whole and is much more than a farming question.

What, for example, is the meaning of disease like contagious abortion?

In my view it is nothing less than a message from Mother Earth that all is not well with the soil which has produced the food on which the cow is fed.

If this is correct, it follows that any attempt to destroy the organism, or to dodge its activities by means of a serum or a vaccine, does not go to the root of the trouble. Such devices are not the right answer to Nature's message. If we slay the bearers of evil tidings or side-track the message, we have not removed the grounds for sending these missives, nor have we done anything to arrest their flow. If we cure one animal, another is certain to fall a victim. Anything short of prevention, therefore, is merely superficial tinkering.

The same line of reasoning applies to virus diseases like foot-and-mouth, which I believe, are constantly being produced in the animals themselves because the proteins on which they are fed are not properly synthesized. It is being re-created everywhere by farming methods which are clearly inadmissible. This would explain why this disease is always breaking out in a fresh place in spite of standstill orders, segregation and slaughter.

The real remedy for most of the disease of dairy cattle is a twofold one: (1) to get the soil fertile to begin with and then to maintain its fertility, and (2) to take an all-round view of the breeding animal and cease to pay attention to one factor only—milk yield. Many years spent in plant breeding have convinced me that the successful variety must always be a compromise. The same principle obviously applies to live stock.

In agriculture the proof of the pudding is in the eating and not in the advocacy of the particular cook. I have this very year in this island of Great Britain seen two outstanding confirmations of the truth of my thesis which has also been verified all over the world. When I kept my own oxen in India, I had no cases of infectious disease over a period of twenty years, although these were rife in the locality and I have even seen my cattle rubbing noses with

foot-and-mouth cases. Nothing happened because my animals were properly selected in the first place, well looked after and fed on the produce of fertile soil. So it will be in this country, once an audacious live wire can be found to carry out a similar test.

What is *muck?* How does it influence the soil? Simple answers to these questions are obviously called for at a time when farmyard manure is again coming into its own.

Muck is an inferior type of humus, obtained as a result of the activities of living organisms—fungi and bacteria—which live in our manure heaps. The first thing to realize is that the muck heap is alive and needs just as much care and thought as do the heifers and the dairy cows. The next point is that the denizens of the ordinary manure heap include a group of bandits—the anaerobic bacteria—which destroy a good deal of the valuable combined nitrogen in the heap, releasing the nitrogen into the air as ammonia or as free nitrogen. This is because the muck heap is unbalanced and contains far too much urine and dung, far too little vegetable waste and an inadequate supply of oxygen from the air. These unfavorable conditions encourage the bandit population which obtain a part of their oxygen from nitrogen complexes in the manure heap.

This great loss of combined nitrogen can be avoided by the proper management of the manure heap—the use of far more bedding for the animals and the proper ventilation of the heap.

*Reform the Manure Heap*

I will gladly send (on receipt of a stamped addressed envelope) to any reader interested details of a simple method of reforming the manure heap, which will multiply the volume of farmyard manure by three and increase the value of each ton of the final product by at least 30 per cent.

It has been done on a large scale; it can be done; it pays to do it. Till it is done and done intelligently, British dairy farming can never prosper, no matter what the price of milk may be and what may be done by the State to help the milk industry. One of the best ways of subsidizing agriculture would be for the Treasury to meet half the cost of putting our muck heaps into really good order and in keeping them in order. It would prove an excellent national investment.

When muck is spread on the surface as a top dressing or ploughed into the soil it gets distributed by the help of earthworms and other burrowing animals, and at once influences the soil in two ways simultaneously — physically and biologically. The general tilth and water-holding capacity of the soil are improved. Coming to the biological aspect, the soil organisms are provided with sustenance and in the process much of the manure is completely oxidized, resulting in the formation of simple chemical salts — nitrates, phosphates and potash compounds which are absorbed by the roots and carried in the sap to the green leaves.

Muck, therefore, looks after the chemical aspects of crop-production and makes such things as artificial manures unnecessary. But this is not the end of the humus story.

Some of the humus in the muck gets into our grasses and clovers direct by means of a living fungus bridge which connects the fertile soil with the sap of plants. It can be seen at work in any good pasture, provided suitable microscopic preparations are made. The fungous threads pass from the humus in the soil right into the tissues of the young roots of the grasses and clovers. Fungus and plant live together in partnership, but eventually the fungous threads are digested and absorbed, the resulting nitrogen complexes passing up in the sap into the green leaves.

Our pasture plants therefore feed in two ways simultaneously: (1) by means of the chemical salts naturally formed in the soil, and (2) by means of Nature's wonder-

ful bridge. This is how Nature—the supreme farmer—arranges her system of balanced manuring for practically all our cultivated crops. All the systems of farming which have passed the test of time have followed her lead. Great Britain and her farmers will, therefore, have to follow suit.

It has been said that there is need of scientific support of my views on humus, which have been very briefly summarized above. Such scientific support is unnecessary because Nature herself has provided the confirmation in the shape of the mycorrhizal association. This as I have said can be seen at work in any pasture in the country. What is the point, therefore, of any further proof? Would any elaborate statistical confirmation of the obvious, even if this were possible, carry us any further? I think not. We usually determine the number of fingers of one hand by simple observation, not by recourse to the findings of statisticians and other laboratory workers. Why not therefore use the same method in observing how humus affects the plant?

In a long experience of the members of the clover family grown for fodder, for fibre and for seed, I invariably found that farmyard manure or freshly prepared humus is essential for the best results. If humus is in short supply, it is possible to raise a crop mainly on the nodule cycle which looks well when in leaf, but such crops never form much seed. This family needs the fertility principle (which is carried by humus) if they are to finish properly—that is, to produce seed. The reason is that they are all mycorrhiza formers.

In days of old our fathers and grandfathers always gave the clover family a good dressing of muck. Then came a present from Germany—a truly Grecian gift—in the shape of the Bernberg experiments, which showed it was possible to raise leguminous crops on nodule nitrogen only. In this way the erroneous idea was introduced into farming that the nodules would solve the nitrogen problem and all would be well with agriculture. No greater disservice has ever been done to the land. It is true leguminous crops can be grown on atmospheric nitrogen by means of their nodules, but this is only a means by which these plants can escape starvation. Only a poor, slow-growing crop can be obtained in this way. A far better crop and one with much more nourishment for live stock is invariably grown with farmyard manure.

The sooner, therefore, the dairy farmers of this country realize that legumes and grasses both need freshly-prepared humus, either naturally produced under the turf by top dressing of farmyard manure or of humus, the better for the health of the cows and the yield and quality of the milk.

# Kitchen Waste and Trenching for the Home Garden

By J. I. Rodale

RUNNING a small farm presents many problems. Out here in Eastern Pennsylvania, in the midst of the Lehigh Valley, we are just far enough from town to be out of the district of kitchen waste collection, and yet not far enough in the country so that kitchen waste may be dropped into any convenient crevice on some unused plot of ground. So the regular disposal of kitchen waste presented a real prob-

lem to us as it has to many land-owners on the outskirts of urban communities.

Since kitchen waste disposal with us was quickly transformed from a theory into a situation that had to be met, we set about to solve the problem in some manner that would be advantageous to our general plans. Of course, we had used our kitchen waste satisfactorily in our compost heaps, but often these heaps were far from the house and on blustery days the journey to them constituted a hardship. The answer to this situation, however, was comparatively simple. It was provided by our garden—close to our back door, and the utilization of the well-known trenching system of fertilization. Not only did it solve the problem of the disposal of our kitchen waste but it also provided a splendid fertilizer where it was needed without the necessity of the work involved in turning the ordinary compost heap. In fact, meeting this kitchen waste disposal proposition presented several new angles to the fertilization of our garden which we believe may be followed advantageously by many suburbanites.

Let it be understood that the garden on our experimental farm is not swept clean of surface vegetation during the Fall. This surface vegetation is left in place as a mulch. This consists of old tomato vines, cabbage stems, grass, etc. Even the old rows are not disturbed. Therefore, the utilization of the trenching kitchen waste disposal idea was comparatively easy.

Between the first and second rows is dug a trench 9 inches wide and about 12 inches deep, the entire length of the rows. The earth from the trench is piled upon the top of the first row.

Along the top of the second row, on the other side of the trench, is piled a combination of old leaves, straw, or other waste material. If compost is available this is a good place to use it most effectively, either separately or mixed with the leaves, straw, etc.

Starting at the end near the house, the daily kitchen waste is dropped into this trench. This kitchen waste is spread out along the bottom of the trench to the depth of about 3 inches. On this kitchen waste is sprinkled a little lime. On top of this is placed a 2 inch layer from the material on the top of the second row, that is, old leaves, straw or compost. Then that part of the trench is filled with earth taken from the top of the first row.

Of course, it would be better if this kitchen waste and leaves, compost, etc. could be mixed slightly before the top earth is put in place. This might be done with a stout stick, a hoe or a pitch fork.

Each day the kitchen waste is deposited in this trench and the trench is filled in just enough to completely bury the kitchen waste so deposited.

When the entire trench is completely loaded another trench will be made between the second and third rows. When this second trench is filled a new one will be dug between the third and fourth rows, and so on until the entire garden has been covered.

It should be remembered that this proposition up to the present time is strictly experimental on our part. However, it seems to bear the earmarks of something really worthwhile. Of course, these trenches should be started in warm weather—right as soon as the frost is out of the ground and even before you start planting your garden. In our case, the trenching had to be suspended when really cold weather hit us but luckily we had already dug a sufficient number of trenches between the old rows of our garden to take care of the kitchen waste for quite a while during the cold weather. The kitchen waste, as it accrues, will be dumped in—no matter how cold the weather may be—but the covering of the trench with dirt will be deferred until a warm spell makes it possible to move the adjoining piled-up soil.

Of course, where the frozen kitchen waste in the open trench would be interfered with by stray dogs and cats, some sort of covering should be given to the trenches. Perhaps some old boards would

do the trick, or sheets of tough corrugated paper, etc.

In our particular case, the trenching was started in our garden along about the first of November. This starting time was merely a happen-so as it marked the completion of our plan to utilize this type of garden fertilization. Several trenches were made during the days that followed but the building of additional ones had to be suspended when the ground froze. Of course, in communities that have no frigid weather the trenching can be successfully done all through the year.

There is only one more point to remember: Ventilation. When we finish filling in a reasonable length of the trench we make ventilation holes along the finished filled-in section about 3 feet apart with an old crow bar. We believe that these ventilation holes are absolutely necessary as it seems probable the same method of decomposition will occur here as in ordinary compost heaps. In compost heaps we have proved that ventilation holes must be present. That our conclusions are sound on this particular point is proved by the comment of Dr. Ehrenfreid Pfeiffer, Kimberton Farms, Phoenixville, Penna., with whom we talked over this proposition a few days ago. He said that it was his opinion that the use of trenches in this manner would be a boon to the small gardener, would solve the kitchen waste disposal proposition in many communities, and that ventilation holes at intervals along the filled-in trenches were advisable. He said that kitchen waste was often used as a means of fertilization in Europe, and that the only trouble with it was that many times the European gardener did not wait until the kitchen waste was thoroughly decomposed before planting his crops. Dr. Pfeiffer said that when the ground was thus used prematurely the plants grown on it became sickly, and were subject to blights and other diseases.

The idea behind this trenching system in the space between the rows in the garden is a practical one. If followed, it will insure an even type of fertilization of the best possible kind. This is the way it works out: The garden next spring will be planted exactly as it was last year. The space between these rows will be thoroughly trenched and filled with kitchen waste during this coming summer and probably a good part of next winter. The following year, however, the rows will be shifted slightly to the side, just enough to have them built over the filled—in trenches. In that way the garden of next year will be a good one—flourishing on the decomposed garden waste.

But our trenching will not stop then. The spaces between these new rows will be trenched and filled with kitchen waste so that when the rows—the following year—are again shifted back to their original positions, the ground there will have been thoroughly fertilized. And thus this process of yearly shifting the rows—with a continuous trenching operation going on between them—will automatically keep the whole garden fertilized to the highest possible degree.

Brought down to simple terms, the trenching-kitchen-waste disposal idea simply means that while you are using half your garden for this year's crops, the other half is being prepared to grow the crops next year. By thus alternating the positions of the rows each year, the whole garden will be brought to a high fertility through the use of kitchen waste.

It should not be overlooked however, that this system calls for a sprinkling of lime on the top of the kitchen waste, as and when it is placed in the trench. The decomposition of kitchen waste has a tendency to create acid conditions, so this light sprinkling of lime is essential to counteract this excess acidity. If lime is not available, wood ashes will serve the same purpose as they are alkaline in character. But do not overdo the lime idea. Just a sprinkling is all that is necessary. Too much lime delays the action of the bacteria.

In our particular case, when the trenching is completed,

we spread over it a mulch of three or more inches of old straw, leaves, etc. This mulch will be left on these trenches during the entire growing season of next year. The home gardener may advantageously follow this plan. This mulch will tend to keep down the weeds between the rows during the growing season, it will serve as a rain block—holding the moisture but preventing erosion—during the Spring storms. A mulch of this character is splendid in preventing the hardening of the surface of the soil. Right in line with "this hardening of the surface" it is well to remember that it has been proved that soil exposed to rain without a cover of vegetation becomes hard and compact under the direct blows of rain drops. This hardened surface is without openings and tends to permit the water to run off, rather than seep into the soil where it is needed.

City and suburban gardeners can use this trench—kitchen waste disposal idea with marked success. It will assure them of bounteous crops, will solve the kitchen waste problem, and the fertilizer headache at the same time. It will require little work because this fertilization will be continuous all year—even while the garden is producing—preparing the soil for next year.

Of course the use of this specially kitchen-waste-fertilizered ground next year will need some preparing. The best method would probably be to semi-trench it again—that is, to open up the old trench, with a shovel or a spade—not necessarily taking out the earth but merely loosening it up thoroughly—thus aerating the soil. This, according to the experiments of Sir Albert Howard should have a tendency to decrease insect attacks on the plants to be grown, and should bring forth exceedingly h e a l t h y vegetables. The following is taken from the latest "News Letter on Compost:"

"During the present summer some interesting observations on the incidence of the black aphis on broad beans were received from two correspondents, which agree with my own experience over a number of years. I have found that the main factor responsible for aphis attacks on this crop is invariably poor soil aeration. Caking of the surface soil or sub-soil is frequently followed by a serious attack. On the other hand, whenever a trench, some 18 inches or so deep, is dug in good time before spring sowing, preferably in the late autumn or early winter, and when the filled-in soil is well composted in good time before sowing, the plants are seldom, if ever, attacked, whatever the season may be.

"The two cases referred to above were both on sandy soil, but of very different character.

"The first was reported by Mr. Hollowell, one of the Housemasters at C h a r t e r house, who observed that some of his rows of broad beans were attacked by black fly, whereas other rows nearby in the same garden escaped. When these rows were removed and the soil broken up by a small cultivator 'where the black fly had been severe, it was almost impossible to get the cultivator into the ground: where there was no fly the cultivator easily went in full depth.' (Letter dated 9th July, 1942).

"The second case occurred on a very fine sand near Fordingbridge in Hampshire on Dr. Westlake's property at Sandy Balls. At the time of my visit in June all the broad beans were attacked by black fly. Examination of the soil showed that the surface had set into a thin but distinct cake. This was broken up. Some time afterwards, Dr. Westlake reported that the affected rows had completely thrown off the pest and that the new leaves were free from blight.

"A simple method of prevention, on soils liable to cake, is to concentrate any spare compost in the upper two or three inches of the strip of soil in which the row of beans is planted."

One more point: if it is possible for the average city gardener to obtain a large can with a tight cover the kitchen waste might be kept above ground, without bury-

ing, for a whole month. This might bring even better results. Experimenting on our farm we found that kitchen waste kept for a full month in a container decomposed very rapidly and when emptied into the garden trench was very close to being a thick liquid. If this procedure is followed—if the kitchen waste is allowed to decompose thoroughly before burying, the ground in the trench could well be used for growing things within six months after the kitchen waste had been placed in the trench instead of waiting a full year. This would shorten the time required for this type of fertilization and would probably be most advantageous to some gardeners.

Another suggestion for the keeping of kitchen waste in the winter when the earth is too hard for digging, would be to construct a fairly large pit at some convenient spot in the ground with a removable wooden cover. Into this pit the kitchen waste could be placed as it accumulates and thus it would be in a half decomposed condition when it was transferred to the trench when warmer weather arrived.

Of course, variations of this idea must be made to meet individual requirements. Perhaps you have sufficient extra space in your yard for this trenching without using any part of your garden this coming summer. If so, you could trench such a spot all this next summer and then lay out your garden the next year on this new location. Or, you may wish to leave half of your present garden without cultivation this coming year and you can utilize such unused part for trenching. No matter how you change this idea, I hope you will let me hear from you regarding such variations you have made and just how this kitchen-waste-disposal plan has worked out in your own particular instance.

In conclusion: let me not overlook the ordinary complaint of the chap who does the garden work. This trenching idea will seem to involve much hard labor. But that is not the case. This is a continuous effort—a little bit each day or so—and the swinging of the pickax and the use of the shovel will actually put new life into the "man of the house."

# The Compost Heap

*Question*: *How often must I water my compost heap? Mine seems to dry out easily.* —Mrs. I. M.

*Answer*: Instructions for making compost state explicitly that the heap must be kept damp—approximately as wet as a squeezed out sponge. Unless it is moist, the bacteria cannot carry out their work of decomposition. So water your compost heap often—and when in doubt—water it again. But do not put on so much water that it runs from the heap. If you do, you will lose valuable nutrient materials. But do not allow your compost heap to dry. If rains are not sufficient—put on water yourself.

*Question*: *How often must I turn the heap?*—J. L. Jr.

*Answer*: Compost heaps should receive their first turn three weeks from the time they are completed. Turn the outside parts into the middle. Be sure to put in your holes for ventilation again after this turn. The second turn should be five weeks after the first turn—mentioned above. Again turn the outside parts of the pile into the center. No ventilation holes need be made after this second turn. Four weeks after the second turn, the heap is done.

*Question*: *Can I use cornstalks in my compost heap? I have a great many of these—some over a year old.*—Mrs. G. L. C.

*Answer*: Corn-stalks present some difficulty as far as making compost is concerned. Corn-stalks are acted upon very slowly by the bacteria—and they refuse to fall apart. However, they may be used in compost heaps after they have been ground up fine and left for several months to disintegrate. Do not use corn stalks "as are" in the heap or you will make nothing but trouble for yourself when it comes time to turn the heaps.

*Question*: *What can I use in the place of manure in the compost heaps? We have very little manure for our garden.* —F. I. McL.

*Answer*: Many things may be used in the place of manure in compost heaps. Kitchen waste is a splendid substitute or waste material from your local slaughter house. Fish cuttings make a good substitute. Any sort of animal matter will prove satisfactory. Dead chickens or the bodies of other animals will work all right. What the manure gives to the compost heap, other animal matter will also supply.

*Question*: *How should I apply compost to my garden—and when? I have a small heap practically done.*—Miss K. G.

*Answer*: Anytime you have the compost finished is a good time to apply it to your garden—or your farm. I have yet to find a garden or a farm that wouldn't do a little bit better with the addition of more compost. It should be spread thin on the top—making it go as far as possible. Even a half inch layer will do wonders but of course the thicker the layer is, the better. This layer may be worked into the soil or left on top—if the climate is not too dry so that it will shrivel up and blow away. The rains will take the nutrients into the soil. You might look at the article on "Kitchen Waste and Trenching For the Garden" in this issue. The method described there is a splendid one for getting the very most out of your compost. Again, just before planting, put compost as a surface dressing over the old trenches. You will be agreeably surprised at the results.

NOTE: Send your questions on making compost to Compost Department care of this publication. Enclose a stamped, self-addressed envelope for a personal reply if desired.

# With Sir Albert Howard

To Sir Albert Howard
Windways, Heversham, Milnthorpe, Westmoreland, England
From J. I. Rodale, Editor
September 29, 1942.

I am beginning to experiment with mechanical devices that would eliminate the turning of compost heaps and I am wondering if you have had any experience along such lines. Do you know of any equipment that might be used to turn over a heap?

One device that we are making, which will be finished today, is shown by the sketch on the enclosed sheet. We call this a "rocking device" because when it is ready to turn, the side marked "A" is pulled down and becomes the bottom and "B" then becomes the side. It is then rocked back when the time comes.

It is so easy to do, possibly with the aid of our tractor, that we might be able to turn the heap much more often, possibly 6 or 7 times instead of twice. Is there any advantage in doing this?

Another thing we are doing is raising it off the ground, with space between the slats and the bottom, so that air could get in from the bottom. Is this an advantage or disadvantage?

Usually it is suggested that the heap be placed directly on the ground so that the bac-

teria could come up from the ground. One disadvantage of this "rocker" is that it does not make a complete turn of the heap. This is only a crude beginning and possibly by a process of development, some day some method will be worked out which will eliminate hand labor in turning.

Another idea that I have in mind of doing soon is to make a long pit. This pit would possibly be 50 or 60 feet long and only 3 feet deep. It would not be too wide, so that an automobile truck could ride over it. It would be possibly 4 or 5 feet wide. The idea here is to make the heap 5 feet high in this pit so that when it settles, it will be but about 3 feet high in the pit and come flush to the top. The idea then would be to place some kind of a bar or tool at the back of the truck which will be low enough to come to the bottom of the pit. As the truck moves, it carries the compost material along with it. Any suggestions or ideas that you might have along these lines will be greatly appreciated.

I am also trying a sheet composting, as follows: On a field that I expect to plant corn next spring, I would like to place raw manure, just as it comes from my steer pens, with the manure spreader. Then within a day or two, at the latest, to cover it completely to the extent of about 2 or 3 inches with green, thin, vegetable matter. Will this be satisfactory? This would eliminate also the matter of turning the heaps.

*Answer*

Many thanks for your interesting letter of September 29th about the mechanization of compost making. I have often suggested to people in this country that the process might be mechanized so as to avoid turning. One of my correspondents is working on this question, but I am afraid his ideas are not simple enough. I like your idea of the rocker very much. I will send it round to some of my

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correspondents and see what we can produce in this country, but in matters of this sort the genius of the American people in regard to mechanization is much superior to our own, so the solution of this problem in all probability will come from the U. S. A.

It will be an advantage to turn the heap several times; that is the experience of large farmers in Rhodesia. I think it is a distinct advantage to raise the compost off the ground, provided the slats in the frame are wide enough to allow of plenty of air getting in. It will never do to have the frame with no ventilation at all, because under these circumstances the wrong type of fermentation is certain to develop. I do not think contact with the ground makes any difference as regards the bacterial population, provided a certain amount of soil is used in making the compost. The direct contact of the ground is entirely a ventilation question, because the earth, as you know, takes in air during the night and gets rid of the used-up air during the day. There is a regular rhythmic breathing, but this will not affect your proposed heaps.

I do not think the long pit you speak of will work in practice, but one never knows in these things.

With regard to your sheet composting, I think the best way would be to reverse the process—to put the green vegetable matter on the ground first and then apply the raw manure, preferably in the form of thin slurry, by means of a liquid manure spreader, over this; then afterwards plough the whole thing in.

*— Eelworm Disease —*

Thank you very much for sending me copies of *Organic Farming* for August and for so kindly reprinting my article on the eelworm disease of potatoes. Curiously enough confirmation of the underlying idea in this article has just come from Rhodesia, where they find that properly made compost stops this disease, as I expected it would. The results are summed up in the following extract from *The Rhodesia Herald* of September 4th, 1942:—

"Some years ago Mr. S. D. Timson, Assistant Agriculturist, noticed a garden in which the vegetables were strong and healthy and the flowers bright and vigorous. He was surprised to learn that three years earlier cultivation had been almost abandoned because of the heavy infestation of eelworm. The excellent conditions he saw followed a good dressing of compost.

He immediately began to observe the results of compost in regard to eelworm, make practical tests and induce farmers to experiment. Once the inquiry was begun evidence began to pour in.

At Darwendale Mr. O. C. Rawson had applied five tons of compost per acre to infested tobacco land. In the first year there was a reduction of eelworm, and in the second year, without a further application, the eelworm disappeared. Other tobacco farmers began to report similar experiences . . . The compost, of course, was applied for its fertilizing value and the consequences on the eelworm population were a surprise.

It now seems that the same effect has been noticed in other countries where compost was being tested out. In Cylong members of the Department of Agriculture were able to report last year that the most promising method of ridding the soil of eelworms was one they had only recently discovered. It had been found that if large quantities of organic material, such as compost, green manure, or cattle manure, were added to the soil the population of eelworm was greatly reduced. Examining into the causes of this effect, their conclusion was that it was due to the increase in the soil, following the addition of organic matter, of organisms like fungi, and insects and other nematodes which preyed on the eelworms. . . .

From Ceylon it is also reported that as research work on plant diseases progressed it was becoming increasingly evident that many of the soil-borne diseases of that island would not be so severe if more care were taken to increase the

amount of humus and organic matter in the soil.

Plants grown in well-cultivated soils, well supplied with organic matter, are not affected by many plant diseases to the same extent as those which are grown in the poorly-cultivated unmanured soils."

If a few of the readers of this journal could treat small areas of infected potato land with compost before the spring and observe the effect on next year's crop, the results might be duly recorded in these pages. As is well known, this disease is on the increase in this country, so anything practical which can be done to safeguard one of our chief food crops will naturally help the war effort.

# The Beneficial Earthworm

THE vegetable mold, made by earth worms, is generally of a blackish color and a few inches in thickness. This mold is one of the best types of humus in existence. It is made by the worm, swallowing the earth, and throwing it out after it has passed through the little creature's digestive system.

Charles Darwin, the first scientist to really investigate the relation of the earthworm to agriculture, stated that it was his absolute conviction that without the earthworm all growing plants would eventually vanish from this earth. Later experiments seem to bear out these conclusions.

Earthworms, through their incessant borings, help aerate the soil and aid the rain to seep into the lower strata. They bring up valuable minerals from the depths to serve as plant food and dying, in vast numbers, furnish the soil with essential protein elements—so necessary to plant growth. It has been estimated, that truly fertile soil should have approximately 1,000,000 earth worms to the acre. This number of worms, in a single year, would manufacture approximately 50 to 150 tons of humus.

While these figures may seem astounding, there is plenty of scientific data to back them up. The real, amazing feature of the earthworm situation is that ordinary commercial fertilizer seems to exterminate them completely from any ground on which these poisons are used and not one farmer in ten thousand realizes — yes, realizes — that when the earthworm vanishes from his soil he is headed for the poorhouse just as surely as day follows night. Commer-


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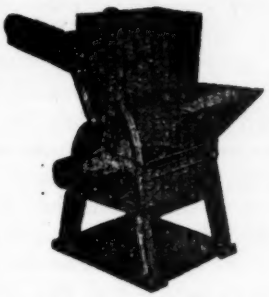

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cial fertilizers may bring temporary stimulus to crops—but this "shot-in-the-arm" type of growing has its dismal morning after awakening—when the "farm has to be abandoned"—as unproductive.

For the above reasons, we advocate the elimination of all poisons from the farm and the garden. We believe in the encouragement – not the annihilation—of the earthworm.

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*Answer*: To date, there is little actual information as to the life span of earthworms, but observations indicate a life expectancy of several years.

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In the latter case, the earthworms literally shrink, as the moisture in their bodies decreases, but they will regain their former size gradually upon restoration of moisture to the soil environment.

Egg capsules often survive a drying-out process that is fatal to the earthworm colonies. The capsules will hatch and develop when the normal condition of dampness is restored.

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To Honorable Cap. Colon
Eloy Alfaro
Ambassador of Ecuador to the
U. S.
Embajada del Ecuador,
Washington, D. C.
October 7, 1942.

We have just come across an item relating to Ecuador. We believe this will be of extreme interest to our eraders. It is to the effect that many horses in Ecuador live exclusively on bananas. This seems strange, although we know of instances in Belgium where cows lived exclusively on fish.

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*Answer*

Replying to your letter of October second regarding the item to the effect that many horses in Ecuador live exclusively on bananas I wish to state that it is quite accurate, particularly on the coast where there is a great abundance of this fruit. And I may add that these horses are the most healthy and efficient I have ever seen.

I trust that this information may be of assistance to you.

Very truly yours,
Col. Austin Albán
Military Attaché.

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ginning to show through the straw. But how those plants did grow after they got started! August 15, they were still in bloom but I turned Pandora and peeked. Right on top of the ground lay big, light colored, perfectly clean potatoes, all ready to be gathered without the work of digging them. Where the straw had been the thinnest the potatoes were slightly covered with soil. The largest potato weighed three quarters of a pound and lay under the deepest straw. How much larger they might have gotten no one will ever know, for gathering them was so much fun, I didn't stop until they were all picked.

It had been a very wet and cold summer and weeds had almost taken the rest of the garden but only under the lightest covering of straw did any weeds get started. The soil was moist and each particle separate but the overcoat of straw kept the fine grains from being eroded. I spread the now dark and partly decayed straw back.

Next year there will be another top-of-the-ground potato patch but instead of using bright straw, I'll use the old rotted straw from this year's patch closest to the ground and dead and partly decayed grasses and weeds on top, so that the growth of the plants will not be held up until the straw starts to rot as happened this year.

I'll try other things besides potatoes, too. This year I noticed a string bean plant that found a spot in the lawn big enough to get its roots down under the dead grass and in competition with the thick turf managed to develop one long bean pod.

My totally untried theory is that if one were to put a thick overcoat of straw or straw-like material on a patch of ground and leave it there from late summer until the next spring that no further preparation of the ground would be necessary and that seeds of various sorts might be planted under this overcoat, taking off a large part of the mulch for plants that do not grow tall. My idea is that the high mulch has been of benefit to the bacteria in the soil and that plants will grow better in such ground even if none of the mulch is returned but that returning as much mulch as possible will still further help the bacteria and will conserve moisture and protect the roots from the hot sun. Still another benefit is that the roots will be able to stay in the richer top soil to feed.

*Answer*

Your suggestion about growing potatoes under a thick mulch, thus permitting the potatoes to grow above ground, and eliminating the necessity of digging them, is rather a new idea to me but it seems basically sound. There is no reason whatsoever having potatoes grow underground, as they receive their nourishment only from their roots, and not through the actual contact with the soil.

In soilless gardening—which we do not advocate for reasons we have spoken about many times—the potatoes are grown in trays above the chemical solution, and do not come in contact with the solution at all, yet they develop satisfactorily. Now, through the use of a thick mulch on your land you have achieved every advantage claimed by the advocates of soilless gardening: you eliminate the weed evil, the bug evil, you make hoeing unnecessary, and finally, you obtain your potatoes without digging. Yes, your method of growing potatoes above ground under a mulch has every advantage attributed to soilless gardening, and yet you have none of the serious disadvantages of "bath-tub farming." The roots of your potatoes find their sustenance in real soil—soil filled with major and minor minerals—something that no man-made chemical solution can ever hope to duplicate. This completely overcomes the deficiencies of soilless gardening while retaining all of its advantages.

But let me make a suggestion as a mere by-stander: since hoeing potatoes is not necessary if the deep surface mulch is used, why should you put the pieces of cut potatoes—used as seed—into rows? Why not sow your mulch covered potato patch like a grain field

—with just sufficient space between the plants to give them elbow room? In that way you should be able to increase the potato yield of your ground at least three fold and, at this time when food is so important to winning the war, this increase of yield would be truly worthwhile.

EDITOR'S NOTE: It is the policy of this publication to encourage anything new in the field of agriculture. But in so doing, we endeavor to convey the idea that the matter is "experimental" and will not be endorsed until it is proven wholly beneficial.

* * *

*Subscriptions to Libraries*

From Mrs. Florence Gunn
Okemos, Michigan
November 21, 1942.

I'd like to get acquainted with people in my community who are interested in natural methods. For fear many who might be interested may not have been lucky enough to have chanced onto the magazine as I did, I am giving a subscription to the local library (State of Michigan Library, Lansing, Mich.). If I make only one new friend with a common interest, I'll feel well repaid.

My purpose is two fold; to help others learn about the magazine and to get acquainted with those interested in natural methods for both social and business purposes.

Perchance there might be someone who, lacking space to work out ideas, might be glad to use some of my 43 depleted acres which must lie idle while I work downtown to earn the living for my youngster and myself.

I believe that many of the more interested readers would be glad to give a few months subscription to the magazine to their local library and thus the news that there is such a magazine would grow. I came across it myself through chance.

I certainly am delighted that you are publishing letters of those who have other methods than the one you advocate. Even if unsuitable, as is, there may be the germ of a new idea there.

*Answer*

We note what you say about sending the subscription to the State of Michigan Library, Lansing, Michigan. This has been done and your bill is enclosed herewith.

We believe this is truly a worthwhile gift because it will afford others the opportunity to learn about organic farming and form an appreciation as to just what real nourishment will do for their health.

It would be fine if more persons would follow your lead and would send a gift ORGANIC GARDENING & FARMING subscription to their local library. We all know that libraries are woe-

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fully under-financed and cannot afford to get many periodicals they actually require. This gift subscription idea would solve this problem, at least as far as ORGANIC GARDENING AND FARMING is concerned.

There is something more that you can do in your community to help this movement along. It is something that is being done by several of our readers and, it is really a substantial step forward in making this organic fertilizer movement a success. We issue each week—an original article suitable for use in a weekly newspaper. This article is written by Mr. J. I. Rodale, is issued in mat form ready to be poured into type by the local newspaper. It needs no typesetting. It is two columns in width and is six inches high. It deals with farming and gardening. It carries no advertising of any kind. It is merely a helpful article on organic fertilization written in simple, non-technical language. This comes to the weekly newspaper without cost—if the weekly newspaper will agree to use these mats—and four of them arrive at one time—a full month's supply. Mr. Rodale is doing this to help spread the gospel of organic fertilization. Perhaps you would like to talk with the editor of your local weekly paper and see if he would want this service.

Impress upon him it is *free* and does not contain any advertiisng matter.

*— Home-made Fertilizers —*

From Albert J. Wyman
Bandon, Oregon
November 12, 1942.

I once used commercial fertilizers regularly but I found out, after a few years, that the stuff grown with them had no vitality. So I quit the commercial kind and have used organic material. My vegetables taste 100% better although they are not quite as large.

* * *

From Mrs. M. P. Waite
677 N. El Molino Avenue
Pasadena, California
November 15, 1942

I am much interested in seeing if a compost heap would solve my difficulties. I now have to burn my grass, leaves, etc. My gardener says that it is full of snails, slugs and insects. I think lime is used in compost heaps—would that kill insect life? Please send me the information.

*Answer*

You state that you now burn your grass and leaves. Lately on our 63 acre experimental farm, here in Eastern Pennsylvania, we have proved conclusively that any spot where the surface of the ground has been burned, the vegetation the following year is very inferior. This would seem to show that no sensible gardener should burn any refuse whatsoever on any spot that is to be cultivated the next year.

In making compost heaps—if properly put together—the heat caused by the bacteria will kill all weed seeds. However, it will not kill the earthworms and other helpful organic life which are very necessary to better the fertility of the garden.

Lime may be used in small amounts in the compost heap in order to counteract acidity, but it should be a very light sprinkling at intervals. A similar sprinkling of wood ashes will accomplish the same result.

* * *

*— No Plowing —*

From T. Skinner
1310 Windsor Avenue
Windsor, Ont., Canada.
December 12, 1942.

Please find enclosed two dollars in Canadian currency to apply on subscription to your magazine: "Organic Gardening & Farming". The sample magazine I have asks "Why Do Farmers Plow?" In the Republic of Panama I noticed that when you plow and sow as in this climate the rains wash the seeds and some of the dirt away. The natives there do not plow but put the point of their machette in the ground making a small opening. The seeds are then planted in this small hole and the earth tamped down on them.

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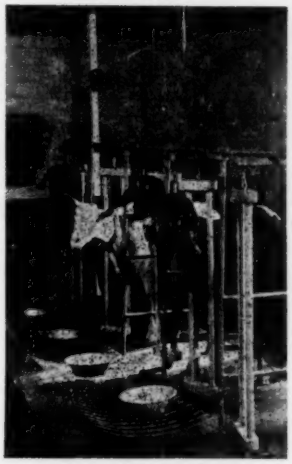

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By Sir Albert Howard, C. I. E., M. A.

Formerly Director Institute of Plant Industry Indore, and Agricultural Adviser to Central India and Rajputana.

SIR ALBERT HOWARD C. I. E., M. A.

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